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PASSIVE SMOKING BEHAVIOUR AND INDIVIDUAL PRODUCTIVITY IN INDONESIA

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ABSTRACT

This research has examined the effect of passive smoking behavior at the household level in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives measured by income and number of working hours. Statistically, smoking male prevalence in Indonesia is around 67% while female smoking prevalence is only 2.1%. To do so, this research used the panel data sourced from Indonesia Family Life Survey (IFLS) 4 and IFLS 5, and compared the results of the three statistical methods: OLS, Fixed Effect, and IV method. Overall, the results show that the smoking behavior of husbands is negatively associated with the income of their wives and that there is no correlation with the number of working hours of their wives. This research also finds evidence that the increase of smokers in wives' community significantly and negatively correlates with their income pointing to community-wide spillover effects.

Penelitian ini telah menguji pengaruh perilaku perokok pasif di level rumah tangga di Indonesia dengan berfokus pada hubungan perilaku merokok suami terhadap produktivitas istri yang bekerja dan tidak merokok yang diukur dengan pendapatan dan jumlah jam kerja. Secara statistik, prevalensi merokok pria di Indonesia sekitar 67% sedangkan prevalensi merokok wanita hanya 2.1%. Penelitian ini menggunakan data panel yang bersumber dari Indonesia Family Life Survey (IFLS) 4 dan IFLS 5, dengan membandingkan hasil dari tiga metode statistik: OLS, Fixed Effect, dan metode IV. Secara keseluruhan, hasil penelitian menunjukkan bahwa perilaku merokok suami berhubungan negatif dengan pendapatan istri mereka dan tidak ada korelasi dengan jumlah jam kerja istri mereka. Penelitian ini juga menemukan bukti bahwa peningkatan jumlah perokok dalam komunitas istri secara signifikan berkorelasi negatif dengan pendapatan mereka.

1. INTRODUCTION

Smoking is the primary cause of preventable deaths (Sung et al. 2006: 5; Zagorsky 2004: 370). However, globally, more than one billion people around the globe are current smokers (Jeffrey and Neil 2018:4). That figure consists of 175 million (15.67%) women and 942 million (84.33%) men aged 15 years and over. In Indonesia, Statistically, smoking male prevalence is around 67% while female smoking prevalence is only 2.1%. Even though cigarette consumption of some countries mainly in developed countries shows a downward trend, cigarette consumption has increased especially in lower and middle-income countries such as Africa and South-East Asia (Jeffrey and Neil 2018:21).

Smoking has an adverse impact on health. Many studies have been conducted related to the impact of smoking on health. For example, Heart disease, lung cancer, and stroke, which are the diseases with the highest probability of death in the world, are strongly associated with smoking habits (Jeffrey and Neil 2018:24). Smoking behavior that affects an individual's health can be classified into two types: active smoking and passive smoking. Passive smoking or commonly known as Environmental Tobacco Smoke (ETS) or Second-Hand Smoke (SHS) refers to non-smokers who inhale accidentally smoke produced by active smokers, both from the smoke exhaled by smokers (mainstream smoke) and smoke from burning cigarette (side-stream smoke) (WHO Report 2003). The International Agency for Research on Cancer classifies second-hand smoke as a dangerous carcinogen that can cause respiratory disorders, lung cancer and other diseases (McGhee et al. 2002: 842). Therefore, both active and passive smoking behavior are associated with many adverse health problems.

In addition to affecting health, active smoking behavior also indirectly has an impact on the other sector, such as individual productivity. Levina et al. (1997), who researched the effect of smoking on wage and employment, explained that workers who were non-smoker earn an average of 6% more than smoking workers. In this research, the level of productivity is measured by income, the number of hours lost, working hours, and the potential flow segment towards 300 employees at an office of a major US airline reservation.

Most research on passive smoking behavior only analyzes the impact of SHS on health (Dartanto et al.2018; Yang et al. 2016). However, still fewer researchers analyzed the impact of smoking on individual productivity, particularly the effect of passive smoking behavior on individual productivity. To fill this gap, this research examines the effect of passive smoking behavior on individual productivity measured by income and number of working hours. Furthermore, this research uses the data in the household level by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives. Therefore, this research focuses to answer the research question: What is the association of smoking behaviour of husbands on income and number of working hours of their wives?

2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Passive Smokers

Smoking habits not only have a negative impact on the health and productivity of smokers themselves but can also have an impact on the health and productivity of people around them (passive smokers). However, based on several searches using the keyword "passive smoking, second-hand smoke or Environment Tobacco Smoke (ETS)" in several journals, research on the effects of passive smoking have focused more on health impacts. In the workplace, people who are intensively exposed to second-hand smoke or ETS, have an increased risk of lung cancer and also increase health expenses by non-smoker workers due to complaints of respiratory illness (Well 1998; McGhee et al. 2002). To overcome that problem, the majority of countries, including Indonesia, have implemented smoking ban policies in public places, including workplaces.

Although smoke-free policies have succeeded in reducing the risk of exposure to second-hand smoke in workplaces (Wortley et al. 2002), this policy is difficult to implement in the household level due to the research showing that smoking behavior of one family member negatively correlates on health of other family members. For example, Yang et al. (2016) examined the health effects of wives as measured by hypertension when having a smoker husband. The result shows that there is a positive relationship between the smoking behavior of husband with hypertension prevalence of wives. Moreover, parental smoking can also bring a negative effect on health. A research conducted by Pattenden et al. in 2006 by using data from The Pollution and The Young (PATY) project in 12 countries in Europe, explained that smoking habits of parents lead an adverse impact on the respiratory health of children, both prenatal and postnatal exposure, such as asthma, wheeze, nocturnal cough and bronchitis.

2.2 The Definition and Factors that Affect Productivity

Based on the OECD report in 2001, generally, productivity is an indicator to measure the level of efficiency or performance of production inputs such as capital and labor, used in the production process to yield a level of output. In the business sector, productivity is a concept that is closely related to the idea of economic growth, partial productivity, profitability, quality and it is part of economic activity (Saari 2006: 1). Productivity measurement aims not only to identify efficiency changes in the production process, but also useful in terms of tracking technical changes, economies of scale, learning by doing, capacity utilization, and also as a major factor in assessing the standard of living as commonly measured by per capita income (OECD Report 2001:11).

There are many types of productivity measurements which depend on the availability of data and also the objectives of measuring productivity. In macroeconomics, the measurement of productivity can be divided into two. First, single-factor productivity or partial productivity is a measurement of productivity which only uses one type of input such as labor productivity as measured by the number of hours worked or capital productivity as quantified by interest income per dollar of capital (Sumanth 1997: 5). Second, total factor productivity (TFP) is a productivity measurement that uses the sum of all input factors in producing output levels to calculate the simultaneous impact of all inputs on the output level (Saari 2006: 1).

Labor productivity, one measure of individual productivity, is an example of partial productivity measurement, which is generally quantified by comparing the volume of output produced with the used input (Freeman 2008: 5). Based on analysis from a production point of view by ignoring the differences in quality, the best measurement of labor input is the number of hours worked. The alternative measures that can be used are hours paid, which can be reflected as labor income (OECD Report 2001: 39). Although labor productivity only describes the meaning of productivity partially, labor productivity remains an essential element to explain the principal economic foundations that offer effective measures of living standards and competitiveness that also affect economic growth (Freeman 2008: 5).

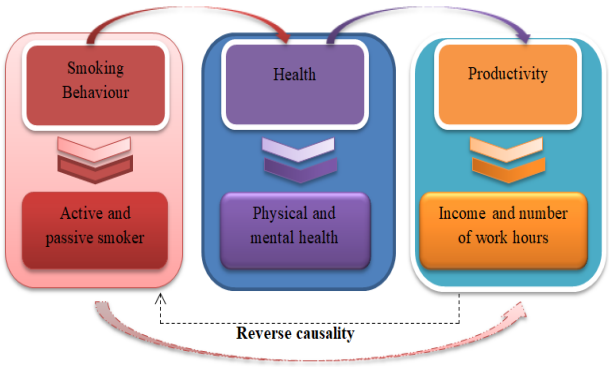
2.3 Conceptual Framework

Several studies have explained how smoking behavior can affect individual productivity. Based on the research conducted by Heijdra and Van der Ploeg (2002), illustrate that marginal individual productivity correlates with the amount of salary. The high salaries indicate the high individual marginal productivity and vice versa. In addition, health economists also describe that the marginal productivity of individuals relates to health that can be generated from smoking or alcohol consumption. From that theories, Individuals who have good health will have a high level of productivity and lead to positively correlate with their income.

Similarly, Kang et al. (2002) describe that smoking habits, both passive and active smokers, generally cause four major diseases such as gastrointestinal, cardiovascular, respiratory diseases, and cancers. Those diseases caused by smoking lead to direct and indirect cost. Direct costs that must be borne by smokers are hospital costs while indirect cost that must be borne is loss of productivity in the form of absence from work, which is measured from loss of working hours. Based on literature reviews, this research theorizes, as depicted in figure 2.1 that smoking habits, both passive and active, can affect the level of individual health due to diseases caused by smoking habit. Then, those health problems will influence the level of individual productivity, which can be measured from their income and the number of working hours.

However, theoretically, health factors and individual productivity such as income can also influence smoking habits. In 2011, Leinsalu et al. studied the effect of income on smoking habits in Hungary, which is one of the less developed countries in Europe. The results of that study concluded that low-income people tend to be positively correlated with smoking continuation. Based on the reverse causality problems, this study will use several econometric techniques to overcome that problem of endogeneity.

Figure 2.1 Conceptual Framework



3. METHODOLOGY

3.1 Data Sources

This study uses secondary data. Specifically, this research uses data sourced from the Indonesian Family Life Survey (IFLS), a survey conducted by RAND (Research ANd Development) which is a non-profit organization based in the United States that is concerned in public policy research, in collaboration with the Universitas Indonesia (UI) and Universitas Gajah Mada (UGM). IFLS data can describe more than 80% of socio-economic and demographic conditions in Indonesia conducted in 15 provinces. This research only utilizes the data from the last two waves of the survey, IFLS 4 and IFLS 5. This research focuses on smoking behavior and health status data available in book 3B, also employment and personal data available in book 3A in IFLS 4 and IFLS 5.

3.2 Variables

Based on the research question, this study attempts to focus on examining the relationship of smoking behavior of husbands on productivities of their working and non-smoking wives in Indonesia. In this research, passive smoking behavior is analyzed at the household level. Therefore, some variables use the data of wives, and some variables use the data of husbands, which are described as follows:

3.2.1 Dependent Variables

Individual productivity is measured by income and the number of working hours. Hence, the data of dependent variables used in this study are only data of individuals as a non-smoking wife who has a job as evidenced by the answer of respondents to the question in book 3A (tk01a) IFLS section employment "During the past week, did you do any of these activities?" Respondents are categorized as having jobs if they choose the option "work for pay".

3.2.2. Independent Variables

There are several types of independent variables in this research: smoking behavior of husbands, human capital and personal characteristics of wives that are educational background and age, and the percentage of smokers in the wives' community. The percentage of smokers in the wives' community variable is measured by using the percentage of smokers in the wives' community obtained by dividing the total number of smokers in each community with the total number of people in that community. The community codes are obtained from the book Htrack (Household Track) IFLS and then merged with smoking behavior data in book 3B IFLS to acquire the number of smokers in each community. All of those variables are used to explain the effect on outcomes.

3.3 Methods

In order to answer the research question, this paper applies three statistical methods: Ordinary Least Square (OLS), Fixed Effect, and Instrumental Variables (IV) method. Based on previous studies, research on the effect of smoking behavior on income causes endogeneity problems.

In this research, the endogeneity problem exists because of reverse causality between outcomes and smoking behavior. For example, the income level of wives can influence the smoking habit of their husbands. Conversely, the smoking behavior of husbands can also negatively affect the income of their wives because of long-term inhalation of cigarette smoke results in health problems. As a result, it can reduce the performance of their wives at work. Also, the endogeneity problem occurs because there are potential unobserved characteristics (confounding variables) that affect both outcomes and smoking behavior, in which case by applying OLS method lead to biased estimates (Levina et al. 1997:4) such as the lifestyle of people. Based on research conducted by Kaleta et al. (2009), smokers generally do not implement and adhere to a healthy lifestyle. Therefore, Fixed Effect and IV method are utilized in this study to overcome the endogeneity problems.

3.3.1 Ordinary Least Square (OLS)

This research still runs OLS regression as a benchmark against Fixed Effect and IV regressions even though the OLS method produces biased estimates due to endogeneity problems. Based on the previous research with the title "More Bad News for Smoker? The effects of Cigarette Smoking on Labour Market Outcomes." conducted by Levina et al. in 1997, the OLS method is used to get the information of cofficients' direction and to compare that results with the direction of coefficients in Fixed Effect dan IV method. The formula for OLS regression is as follows:

$$PS_i = \alpha_0 + Smoke_i\beta_1 + X_i\beta_2 + \varepsilon_{it}$$

PS	:	Individual productivity of working and non-smoker wives (Passive Smokers) as a dependent variable is measured into two ways: income and number of working hours.
Smoke	:	There are two ways to define smoking behavior of her husbands: Smoking behavior tries to capture smoking intensity measured by how many cigarettes are consumed by the respondent per day (Continuous)

		Smoking Behavior is classified into four categories (Categorical) 1. Non-smoker (0) 2. Former smoker (1) 3. Light smoker (2) 4. Heavy smoker (3)
X_i : Education	:	Educational level of wife is classified into four categories: 1. Never attend school (0) 2. Up to elementary school (1) 3. Up to senior high school (2) and 4. Up to higher education (3)
X_i : Age and Age^2	:	Age of wife
X_i : Percentage of Smoker in Community	:	Percentage of Smoker in Wives' Community

3.3.2 Fixed Effect and Instrumental Variable

As explained earlier, the Fixed Effect and IV method are used in this study to overcome the endogeneity problems in the model. Based on the research of Levine et al. (1997), applying individual Fixed Effects or panel data techniques is useful to account the effects of the unobservable heterogeneity. In addition, analyzing the relationship between changes in smoking behaviour and changes in outcomes over time will control individual characteristics that are constant over time. The equation for the Fixed Effect method by using two waves of IFLS is as follows:

$$\mathrm{PS}_{\mathrm{it}} = \alpha_0 + \mathrm{Smoke}_{\mathrm{it}}\beta + \mathrm{X}_{\mathrm{it}}\gamma + \delta_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$\Delta\mathrm{PS}_{\mathrm{i}} = \alpha_0 + \Delta\mathrm{Smoke}_{\mathrm{i}}\beta + \Delta\mathrm{X}_{\mathrm{i}}\gamma + \Delta\varepsilon_{\mathrm{i}}$ Where δ_{i} describes Individual Fixed Effect.

However, Fixed Effect method is not the best method to overcome the problem of endogeneity in the model because this method eliminates time-constant explanatory variables so that it does not solve the problem of "time-varying omitted variables" (Wooldridge 2016: 461). He also stated that the best and most popular method to conquer the endogeneity problem in the model is by applying IV method.

Two requirements must be fulfilled to obtain a valid and strong IV that can tackle the endogeneity problems in the model (Wooldridge 2016 464; Leigh and Schembri 2004: 286). First, that instrument correlates with the treatment variable. If the correlation between those two variables is strong, then the instrument can be described as having a robust in the first stage. Second, the instrument variable must not correlate with error terms or may not have a direct relationship with outcomes.

A research conducted by Leigh and Schembri (2003) explains that cigarette price is a valid and robust IV to measure the effect of smoking on health because that instrument meets the two conditions above. First, cigarette price affects smoking behavior. Logically, when the price of cigarettes increases, the consumption of cigarettes will decrease. The study conducted by Ayda et al. (2004:59) stated that the price elasticity of tobacco consumption ranges from -0.14 to -1.23, but most of the results from developed countries are under the range of -0.3 to -0.5. Second, the price of cigarettes does not correlate directly with an individual's health. By using the same way of thinking, the cigarette price is also a valid variable instrument that can be used to overcome the problem of endogeneity in explaining the influence of smoking behavior on income.

However, the Instrumental Variable (IV) used in this research paper is quite different from that previous research. The previous studies use cigarette price as IV while this paper utilizes the price of cigarettes in the year when the respondents as husbands started to smoke for the first time as IV because that price may be a factor for people to start their smoking behavior. Then, the category of respondents identified with the IV is the respondents as husbands who are still current smokers. That IV is used in this paper because the data of cigarette prices is not available in IFLS and also the price of cigarettes in all regions of Indonesia is almost the same. Nevertheless, that IV still has weaknesses because maybe the price of cigarettes is not one of the main considerations for people to start smoking, there are many other factors such as environmental conditions, parental smoking and so on.

The data of respondents when they started smoking for the first time are obtained from book 3B IFLS through the question "At what age do you start to smoke on a regular base?" and the price of cigarettes per year is sourced from Tobacco Economics in Indonesia Report and Cigarette Affordability in Indonesia Report. Moreover, the price of cigarettes used as IV is the real prices of cigarettes which can describe people's purchasing power because those prices take into account the inflation rate in the year concerned. The conversion of the nominal price to the real price of cigarette uses the following formula:

$$Real\ Price\ at\ time\ t = \frac{Nominal\ Price\ at\ time\ t}{(\frac{CPI\ at\ time\ t}{100})}$$

Where:

CPI is the Consumer Price Index which describes changes in the price level of goods and services purchased by households. The reference base period of CPI used in this study is 2010, which is sourced from the World Bank Database.

3.3.3 Logistic Regression

This method is applied to explain the association of husbands smoking habits on the health status of their wives because it has been demonstrated previously in the conceptual framework that smoking affects individual productivity through health factors. In this research, the health effects of wives due to their husbands smoking habits are measured by acute morbidity associated with respiratory problems experienced by wives such as cough (dry cough, cough with phlegm or bloody cough), difficulty breathing (Wheezing or short, rapid breath), or feel chest pains. The data is obtained from the book 3B section Acute Morbidity in IFLS 4 and IFLS 5.

Furthermore, the statistical method used to measure the health impact of wives due to the smoking behavior of their husbands is logistic regression. The logit function, the natural log of the odds (probability/ (1-probability)), is utilized when the dependent variable is categorical data. In this study, the health level of wives as an outcome is categorized in the binomial variable (1, 0). The wife who has experienced at least one of the acute comorbidities associated with respiratory tract disorders can be categorized as 1 while the wife who has never suffered from severe comorbidities can be classified as 0. The model of logistic regression is as follows:

$$Log\ (\frac{p}{1-p}) = \alpha_0 + Smoke_i\beta_1 + \varepsilon_i$$

Where: p is the probability of the wife suffering from acute comorbidity related to the respiratory tract.

Odd ratio (OR) is often used in medical research papers because it is very convenient to interpret case-control studies through OR (Bland and Altman 2000). In this analysis, OR is defined as the ratio of two probabilities: the probability of the wife suffering from acute comorbidity related to the respiratory tract (p) to the likelihood of the wife not suffering from severe comorbidity associated with the respiratory tract (1-p). Similar with the previous method, there are two ways to define smoking behavior of her husbands that are the number of cigarettes consumed per day and categorical variables of smoking habit.

3.4 Descriptive Analysis

In examining the association of smoking behavior of husbands on individual productivity of their wives measured by income and number of working hours, this research paper utilizes panel data. The panel data used is the combined data of IFLS 4 and IFLS 5. The number of observations after making several adjustments is 1,416 observations. Descriptive statistics for 1,416 observations are presented in table 3.1. According to that table, the average income of respondents as wives is IDR 246,085 per week and the average of working hours is 47 hours per week.

Furthermore, the mean price of cigarette as an IV in this research is IDR 5,699 with the real minimum price occurred in 1966 was IDR 931, and the maximum real price occurred in 2018 was IDR 12,417 as seen in table 3.1 and chart 3.1. That chart describes changes in nominal and real prices of cigarettes from 1960 to 2016. According to that chart, the nominal price of cigarettes was fairly stable during the period 1960 to 1997 and experienced a rapid increase in 1998 when the financial crisis in Asia harmed the Indonesian economy. On the other hand, changes in real cigarette prices fluctuated slightly, although overall there was an increase in real cigarette prices in 2016 compared to 1960.

4. RESULTS

4.1 The Association of Smoking Behavior of Husbands on Health of Their Wives

Besides being able to cause chronic diseases such as lung cancer and heart failure, generally, passive smokers will be affected by respiratory tract disorders due to inhaled side-stream smoke for a long time (Schick and Glantz 2005; Well 1998; McGhee et al. 2002; Kang et al. 2002). As explained in the method section, this research uses the model of logistic regression.

Table 4.1 describes OR in measuring how strong the association between smoking behavior of husbands as exposure and health status of their wives as an outcome. If OR> 1, means that exposure associated with higher odds of the outcome. Overall, the majority of OR numbers in table 4.1 are greater than 1. In other words, the smoking habit of husbands associated with higher odds of wives exposed to respiratory problems. If the smoking behavior of husbands is measured by the number of cigarettes consumed, the regression result by using IFLS 5 data shows that for one unit increase in the number of cigarettes consumed by husbands, the odds of wives getting acute comorbidities in respiratory problems increased by 1.018 times. Whereas, the regression results by using the data of IFLS 4 and the combined

data of IFLS 4 and 5 cannot be concluded as a substantial relationship between two variables because the odd ratio data are not significant.

On the other hand, if the smoking behavior of husbands is measured by categorical variables, consistent results are presented either using the data of IFLS 5 or IFLS 4. Husbands categorized as heavy smokers have the greatest odds ratio of having a wife affected by acute comorbidities in respiratory problems. In other words, smoking habits of husbands negatively correlate with the health status of their wives.

4.2 The Association of Smoking Behavior of Husbands on Income of Their Wives

After analyzing the association between the smoking behavior of husbands and the health effects of their wives, this study concludes that smoking husbands adversely affect the respiratory system of their wives. Therefore, this research will then examine the association of husbands smoking habits on the productivities of their wives to answer the research questions.

4.2.1 OLS and Fixed Effect Method

This section reports the results of OLS and Fixed Effects regression in analyzing the association between smoking behavior of husbands and income from their wives by involving several explanatory variables such as age, educational levels and percentages of smokers in wives' community. The results of the regressions are presented in table 4.2. On that table, column (1) and (2) describe the regression results if the smoking behavior of husbands is measured by the number of cigarettes consumed per day, while column (3) and (4) illustrate the regression results if smoking behavior of husbands classified into four categories: Non-smokers, former smokers, light smokers and heavy smokers. Based on the estimation results in column (1) and (2), there is a positive correlation between the income of wives and the number of cigarettes consumed by their husbands both using OLS and Fixed Effect method. However, as explained in the method section, the OLS method produces biased estimates due to endogeneity problems and Fixed Effect method is not the best method to overcome the problem of endogeneity in the model because this method eliminates time-constant explanatory variables. Based on the study conducted by Braakman (2008: 11), there are two possible explanations for positive correlations between smoking behavior and wages. First, the effects of smoking on health, especially chronic diseases, will appear in the future and are not a problem for people in the group age 20 to 55 years old. Second, the health status is more critical to the question of whether people can find work or not than the amount of wages received.

On the other hand, by using categorical variables to measure smoking behavior of husbands as shown in column (3) and column (4), OLS coefficient estimates that being light smokers' husbands decrease the income of their wives by 6.8 percentage points compared to being non-smokers husbands, while the Fixed Effect coefficient almost doubles that OLS effect but not significant (p = .38).

Nevertheless, the regression results of OLS are different from the previous studies conducted by Levina et al. (1997) and Bondzie (2016) who research the impact of active smoking behavior on individual productivity. Both of those papers also use the OLS method as comparison results with other methods. By using the categorical variable of smoking behavior, their OLS results stated that smokers significantly earn less compared to non-smokers. As explained in the previous chapter, the use of OLS method in examining the effect of smoking on income results in endogeneity problems. According to Wooldridge (2016: 461), the best method for dealing with endogeneity problems in models is applying the IV method. Therefore, in the next section, this research tries to use the IV method and compares the regression results with the OLS and Fixed Effect models.

Another explanatory variable that is important to discuss based on the results of regression is the percentage of smoker in the wives' community. This variable can represent the impact of cigarette smoke from the surrounding environment on the productivities of wives. Based on table 4.2, there is a negative and significant correlation between percentage smoker in wives' community and their income both using OLS and Fixed Effect. The OLS coefficient in column (1) and (3) estimates that a one percentage points increase in the percentage of smoker in wives' community would yield a 105.6 and 103.9 percentage points decrease in the income of wives respectively. Similar to the OLS estimates, the Fixed Effect regression results as illustrated in column (2) and (4) point to a negatively sizeable effect of the percentage of smoker in wives' community on their income. As a result, it can be concluded that the increase in the amount of smoker in the community around the wives results in greater intensity of exposure to cigarette smoke which ultimately harms their income through health factor.

4.2.2 Instrumental Variable

Based on the previous research that have examined smoking effects on income, the endogeneity problems exist because reverse causality between smoking and income and also there are potential

unobservable characteristics that affect both wages and smoking behaviors. One example of unobserved characteristics of individuals explained in research conducted by Levina et al. (1997: 4) is “measure of judgment”. If people with poor assessment tend to choose to smoke and there are no variables in the model related to the size of that assessment, then low wages due to poor judgment will always be associated with smoking habits.

Because of the endogeneity problems, applying OLS methods lead to biased estimates. Therefore, the application of the IV method is needed as the best and most popular method for overcoming the problem of endogeneity in the model compared to the fixed effect method (Wooldridge 2016: 461). As explained in the method section, the price of cigarettes in the year when the respondents as husbands start smoking is utilized as IV because that price may be a factor for people to start their smoking behavior. Then, the category of respondents identified with the IV is the respondents as husbands who are still current smokers. The result is presented in table 4.3 by showing regression in stages to investigate changes in the coefficient of income while adding another explanatory variable and comparing the result with the OLS estimates. By using the IV method, there is a negative correlation between smoking behavior of husbands measured by the number of cigarettes on the income of their wives. The direction of that coefficient is different with the regression results of the Fixed Effect and OLS method.

Overall, the smoking behavior of husbands negatively associated with the income of their wives by 11.5 to 21 percentage points at 5 and 10 percent significance level only in columns 2, 3 and 4. By adding the variable percentage of smokers in the wives’ community, the correlation between numbers of cigarettes and income of wives is still negative but statistically insignificant. The direction of that correlation is in line with the previous studies, as shown in table 4.3. Also, the results of the firsts stage regressions revealed that the price of cigarettes as an instrumental variable is significant statistically.

Besides, the direction of the coefficient of other control variables by utilizing IV method is consistent with the OLS estimates, while the magnitude of the coefficient is bigger than OLS. For example, the coefficient variable percentage of smokers in wives’ community decreases by 10.28 percentage points compared to the OLS result. The IV estimate for that variable implies that a one percentage point increase in the percentage of smoker in wives’ community would significantly decrease the income of wives by 114 percentages points.

4.3 The Association of Smoking Behavior of Husbands on Income of Number of Working Hours

Based on the research question, in addition to analyzing the association between smoking behavior of husbands and income of their wives, this research also examines the association of husbands smoking habits on the number of working hours of their wives. The similar method used in analyzing the association of smoking on income, this section also uses three estimations techniques: Pooled OLS; and Fixed Effect and IV method to control reverse causality in the model. The results of those regressions are shown in table 4.4. Using the OLS method, there is a difference in the direction of coefficient between smoking behavior of husband measured by the number of cigarettes consumed in column (1) and classified with categorical data in column (3). However, due to endogeneity problems, the estimates generated by the OLS method are biased. By using Fixed Effect method presented in column (2) and (4), the estimated relationships between changes in smoking behavior of husbands and changes in the number of working hours of their wives show a negative correlation, but the coefficient is quite small and statistically insignificant. The Fixed effect estimates in column (2) imply that a one percentage point increase in the change in the number of cigarettes consumed by husband is associated with a 0.028 percentage points decrease in the change of number of working hours of their wives.

As the best method of controlling the endogeneity problems, the direction of IV coefficient as seen in column (5) is similar with Fixed Effect, there is a negative correlation between smoking behaviors of husbands on the number of working hours of their wives, and remains statistically insignificant. The IV estimates means that an increase one unit of cigarette consumed by husbands lead to decrease the number of working hours of their wives by 1.18 percentage points. However, the size of the IV coefficient is bigger than Fixed Effect. Therefore, overall, it can be concluded that the husband's smoking habits do not correlate with the number of working hours of the wife ($r(1340)= .0018$ $p=.59$) The results of this study are similar with the results of a study conducted by Levina et al. (1997: 13), who concluded that active smoking has not significantly correlated with the number of working hours.

Furthermore, stata results in table 4.4. also show that there are mixed results in analyzing the association of the education level of wives on the number of their working hours, but mostly the association between those variables is negative and statistically insignificant. That might be explained logically that the higher the level of education, the

higher the salary generated so that people with high-level education do not have to work long hours in a day to meet their daily needs. Also, there are mixed results in analyzing the impact of the percentages number of smokers in the wives' community on the number of their working hours. Nevertheless, by using the IV method, the coefficient is negative by 4.8 percentage points but remains statistically insignificant.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Smoking behaviour, both active and passive, has an adverse effect on health. Moreover, some researchers have analyzed that passive smoking is even more dangerous than active smoking (Schick and Glantz 2005; Raupach et al. 2005) because people who inhale side-stream smoke will be contaminated with four times as much toxic substance as the smoke that is inhaled by active smokers. Besides affecting the health sector, smoking behavior also indirectly influences individual productivity (Levina et al. 1997; Halpren et al. 2001; Ours 2004; Braakman 2008; Bondzie 2016; Amalia 2018). However, those studies only focus on the impact of active smoking behavior, while research related to passive smoking behavior mostly focuses on the health sector (Well 1998; McGhee et al. 2002; Yolton et al. 2004; Yang et al. 2016; Dartanto et al. 2018).

Therefore, this research examines the association between passive smoking behavior and individual productivity at the household level in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives measured by income and number of working hours.. By comparing the result of three statistical methods: Ordinary Least Square (OLS), Fixed Effect, and Instrumental Variables (IV) and using the panel data sourced from IFLS 4 and IFLS 5, this paper tries to answer the research question: What is the association of smoking behavior of husbands on income and number of working hours of their wives?

Based on the analyses in previous section, by implementing the price of cigarettes as Instrumental Variable to overcome the endogeneity problems in the model, this research finds that smoking behavior of husbands affects negatively on the income of their wives by 11.5 to 21 percentage point at 5 and 10 percent significance level. Also, by using the Fixed Effect method, there is a negative correlation between smoking behavior of husbands measured by categorical data on the income of their wives. However, those correlations are statistically insignificant. The direction of that coefficient is in line with the previous studies (Levina et al. 1997; Ours 2004, Kvasnica 2010; Bondzie 2016).

On the other hand, the smoking behaviors of husbands do not correlate with the number of working hours of their wives. Both using Fixed Effect and IV method show a negative correlation between smoking behavior of husbands and number of working hours of their wives, but the coefficient is quite small: 0.0028 and 1.18 percentage points respectively and statistically insignificant.

Furthermore, the other explanatory variables such as age and the educational level show the regression results with expected signs and in line with previous studies (Levina et al. 1997; Ours 2004; Bondzie 2016; Amalia 2018). The increase of the age of wives leads to an increase in their income and number of working hours, but the age has a turning point or parabolic shape described in the age square variable. However, there is a difference in the direction of coefficient between the impact of education on income and the number of working hours. If the outcome is income, the higher the educational level of the wives, the higher the income they earn. If the outcome is the number of working hours, mostly the association between the education level of wives and the number of working hours is negative and statistically insignificant. That might be explained logically that the higher the level of education, the higher the salary generated so that people with high-level education do not need to work long hours in a day to meet their daily needs.

Another essential explanatory variable that must be considered is the percentage of smoker in the wives' community. All regression results agree that the increase in the number of smoker in the community around the wives results in greater intensity of exposure to cigarette smoke, which ultimately harms their income. By using standardized regression coefficients in OLS estimates, this variable has a stronger coefficient than the variable number of cigarette smoking of husbands..

In sum, by combining all the findings, the results show that the smoking behavior of husbands is negatively associated with the income of their wives and that there is no correlation with the number of working hours of their wives. This paper also finds evidence that the increase of smokers in wives' community significantly and negatively correlates with their income pointing to community-wide spillover effects.

5.2 Policy Recommendation

The findings in this research may provide empirical evidence about the association of being

passive smokers on their productivity, especially in Indonesia. Although many studies have analyzed the impact of smoking behavior on individual productivity, those studies only focus on the impact of active smokers on their productivity. The Empirical essential evidence in this study related to the effect of exposure to cigarette smoke obtained from people in the surrounding environment has a more significant impact on individual productivity compared to exposure to cigarette smoke obtained in the household.

Therefore, for policy recommendations, based on IFLS data used in this study, approximately 33% of total respondents start smoking at the age of under 18 years. In this case, the government must tighten the rules on buying and selling cigarettes in stores. One way that can be implemented by the government so that children under the 18 years old do not consume cigarettes is by formulating regulations regarding the purchase of cigarettes by showing the identity card. That regulation has been enforced in several countries in the world and success in reducing the number of child smokers.

5.3 Limitation and Future Research

There are several limitations in this research considering the source of data and the methodology that have been applied to answer the research question. Explicitly, this study uses the Indonesian Family Life Survey (IFLS) data that represents more than 80% of social, economic and demographic conditions in Indonesia and can be accessed freely through the website. However, IFLS data do not reflect the population in eastern Indonesia because the survey is only conducted in the majority of provinces in western and central Indonesia.

Besides, there is an endogeneity problem in this research in examining the relationship between outcomes and smoking behavior. Based on the Wooldridge (2016), the best technique for managing the endogeneity problem is by using Instrumental Variable (IV). The instrumental variable (IV) used in this research paper is quite different from that previous research. The previous studies use cigarette price as IV while this paper utilizes the price of cigarettes in the year when the respondents as husbands started to smoke for the first time as IV because that price may be a factor for people to start their smoking behavior. That IV is used in this paper because the data of cigarette prices is not available in IFLS and also the price of cigarettes in all regions of Indonesia is almost the same. Also, the IV in this research still has weaknesses because maybe the price of cigarettes is not one of the main considerations for people to start smoking, there are many other factors such as environmental conditions, parental smoking and so on.

The future work might be able to analyze the impact of smoking behavior on individual productivity by comparing smokers who use e-cigarettes and conventional cigarettes in Indonesia. Electric cigarettes are becoming increasingly popular among the public so it is necessary to know whether e-cigarettes are less dangerous compared to conventional cigarettes or vice versa. In addition, the future research can also examine the same topic using other data sources such as Indonesia National Socio Economic Survey data because as explained in the limitation, IFLS data do not reflect the population in eastern Indonesia because the survey is only conducted in the majority of provinces in western and central Indonesia.

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Table 3.1 Descriptive Statistics

Variables	Description	Mean	St. Dev	Min	Max
Income	weekly income of wife	246,085	33,0442.2	5000	2,076,923
Log Income	Log of weekly wife's income	11.70	1.24	8.51	14.54
Working Hours	Weekly working hours of wife	46.99	23.53	9	126
Log Working Hours	Log of weekly wife's working hours	3.72	0.53	2.19	4.84
Number of cigarette	Number of cigarette consumed per day of husband	11.81	7.78	0	64
Smoking Behaviour	Smoking behavior of husband: • Non-smoker (0), • Current Smoker (1), • Light Smoker (2), • Heavy Smoker (3)	2.69	0.67	0	3
Age start to smoke	the age of the husband when he first started smoking	19.63	6.63	4	73
Educational Level	The educational level of wife: • Never attend school (0) • Up to elementary school (1) • Up to senior high school • Up to higher education (3)	1.59	0.79	0	3
Age	Age of wife	41.62	9.87	19	75
Age^2	Age Squared of wife	1,829.65	845.38	361	5,625
Percentage of Smokers in Community	Percentage of Smokers in Wives' Community	0.506	0.19	0.12	1
Respiratory problem	health effects on the respiratory tract felt by the wife	0.73		0	1
Price of Cigarettes	Real price of cigarettes	5,699	1,664	931.63	12,417

Chart 3.1 Nominal and Real Prices of Cigarette in Indonesia from 1960 to 2016

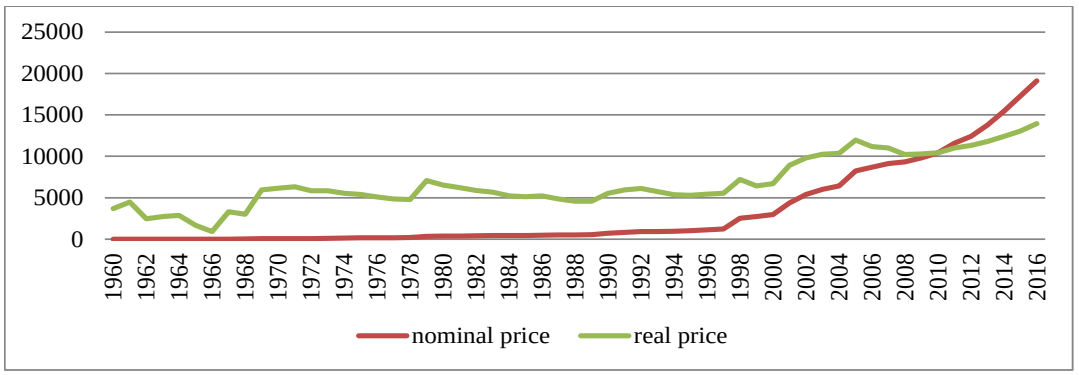

Table 1.1 The Regression Results in Examining the Association of Smoking Behaviour of Husbands on Respiratory Health of Their Wives

Variables	Odd Ratios						LPM with Fixed Effect	
	IFLS 5		IFLS 4		IFLS 4 + IFLS 5			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of cigarette	1.018***		1.011		0.999		-0.00126	
	(0.00628)		(0.00763)		(0.00762)		(0.00145)	
Baseline: Non-smokers								
1. Former smokers		1.804**		1.222		1.294		
		(0.480)		(0.341)		(0.477)		
2.Light smokers		2.567***		1.938***		1.777*		0.0617*
		(0.632)		(0.440)		(0.585)		(0.0347)
3.Heavy Smokers		3.743***		2.321***		1.869*		0.0499*
		(0.975)		(0.579)		(0.642)		(0.0386)
dIFLS4							0.0282**	0.0326***
							(0.0115)	(0.0118)
Constant	3.048***	1.467	2.400***	1.444*	2.702***	1.562	0.0594***	-0.00870
	(0.266)	(0.347)	(0.235)	(0.313)	(0.293)	(0.500)	(0.0182)	(0.0324)
Observations	2,390		1,721		1,416		1,416	

Note: Data of IFLS 4 + IFLS 5 is panel data. In the process of combined data, some respondents were not interviewed in IFLS 5 but interviewed in IFLS 4 and vice versa (such as new respondents in IFLS 5). As a result, there are 1,416 observations from 708 respondents interviewed both on IFLS 4 and IFLS 5.Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 4.2 Regression Results in Examining the Association of Smoking Behavior of Husbands on Income of Their wives (Dep. Variable: Log weekly Income of Wives)

	(1)	(2)	(3)	(4)
VARIABLES	OLS	Fixed Effect	OLS	Fixed Effect
Number of Cigarettes (Husband)	0.0145***	0.00977*		
	(0.00378)	(0.00539)		
Base: Non Smoker (Husband)				
1. Former Smoker			0.291	
			(0.197)	
2. Light Smoker			-0.0686	-0.131
			(0.177)	(0.300)
3. Heavy Smoker			0.197	-0.00417
			(0.184)	(0.309)
Age (Wife)	0.139***	0.120*	0.138***	0.111*
	(0.0209)	(0.0649)	(0.0209)	(0.0653)
Age^2 (Wife)	-0.00147***	-0.00102***	-0.00148***	-0.000976***
	(0.000244)	(0.000336)	(0.000244)	(0.000338)
Base: Never attend school (Wife)				
1. Up to Elementary School	0.404***	-0.209	0.410***	-0.223
	(0.139)	(0.293)	(0.139)	(0.295)
2. Up to Senior High School	0.874***	-0.556	0.860***	-0.588
	(0.145)	(0.367)	(0.145)	(0.369)
3. Up to Higher Education	1.742***	-0.748	1.712***	-0.808
	(0.155)	(0.450)	(0.155)	(0.453)
Percentage of smokers in wives' community	-1.056***	-0.582**	-1.039***	-0.597**
	(0.155)	(0.244)	(0.155)	(0.245)
dIFLS4		0.712*		0.774*
		(0.399)		(0.400)
Constant	8.223***	8.217***	8.413***	8.727***
	(0.465)	(2.287)	(0.502)	(2.323)
Observations	1,416	1,416	1,416	1,416
R-squared	0.227	0.361	0.231	0.362

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4.3 Result of IV Estimates in Examining the Association of Smoking Behavior of Husbands on Income of Their Wives (Dep. Variable: Log weekly Income of Wives)

VARIABLES	IV					OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Cigarettes (Husband)	-0.137	-0.210**	-0.202**	-0.115*	-0.0723	0.0145***
	(0.0915)	(0.106)	(0.102)	(0.0647)	(0.0525)	(0.00378)
Age (Wife)		0.0135**	0.203***	0.172***	0.151***	0.139***
		(0.00617)	(0.0544)	(0.0373)	(0.0314)	(0.0209)
Age^2 (Wife)			-0.00229***	-0.00174***	-0.00157***	-0.00147***
			(0.000655)	(0.000440)	(0.000372)	(0.000244)
Base: Never attend school (Wife)						
1. Up to Elementary School				0.680***	0.554***	0.404***
				(0.250)	(0.210)	(0.139)
2. Up to Senior High School				1.322***	1.098***	0.874***
				(0.301)	(0.249)	(0.145)
3. Up to Higher Education				2.183***	1.952***	1.742***
				(0.309)	(0.255)	(0.155)
Percentage of smokers in wives' community					-1.147***	-1.056***
					(0.197)	(0.155)
Constant	13.41***	13.75***	9.927***	8.062***	8.866***	8.223***
	(1.118)	(1.344)	(1.105)	(0.703)	(0.639)	(0.465)
Observations	1,341	1,341	1,341	1,341	1,341	1,416

Note: the category of respondents identified with the IV is the respondents as husbands who are still current smokers. Therefore, total observations in IV method are 1,341 after dropping observations where the husband smokes zero currently. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4.4 Result of Regressions Estimates in Examining the Association of Smoking Behavior of Husbands on Number of Working Hours of Their Wives

(Dependent Variable: Log weekly Working Hours of Wives)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS	Fixed Effect	OLS	Fixed Effect	IV
Number of Cigarettes (Husband)	-0.000147	-0.000280			-0.0118
	(0.00181)	(0.00308)			(0.0256)
Base: Non Smoker (Husband)					
1. Former Smoker			0.184*		
			(0.0945)		
2. Light Smoker			0.187**	0.00207	
			(0.0849)	(0.171)	
3. Heavy Smoker			0.158*	-0.0313	
			(0.0882)	(0.176)	
Age (Wife)	0.0100	0.0702*	0.0104	0.0731*	0.0233*
	(0.0100)	(0.0371)	(0.01000)	(0.0373)	(0.0129)
Age^2 (Wife)	-0.000154	-0.000389**	-0.000154	-0.000410**	-0.000319**
	(0.000117)	(0.000192)	(0.000117)	(0.000193)	(0.000153)
Base: Never attend school (Wife)					
1. Up to Elementary School	0.137**	-0.0612	0.136**	-0.0628	0.154*
	(0.0666)	(0.167)	(0.0665)	(0.168)	(0.0917)
2. Up to Senior High School	0.134*	-0.0650	0.133*	-0.0610	0.166
	(0.0694)	(0.210)	(0.0693)	(0.211)	(0.113)
3. Up to Higher Education	-0.0737	-0.150	-0.0730	-0.139	-0.0336
	(0.0744)	(0.257)	(0.0745)	(0.258)	(0.117)
Percentage of smokers in wives' community	-0.00392	0.290**	0.00623	0.284**	-0.0481
	(0.0741)	(0.139)	(0.0743)	(0.140)	(0.0836)
dIFLS4		-0.199		-0.213	
		(0.228)		(0.228)	
Constant	3.488***	1.537	3.292***	1.461	3.375***
	(0.223)	(1.306)	(0.241)	(1.325)	(0.280)
Observations	1,416	1,416	1,416	1,416	1,341
R-squared	0.026	0.016	0.029	0.017	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1